DEPARTMENT OF
CALIFORNIA HIGHWAY PATROL

ENFORCEMENT SERVICES DIVISION
FIELD SUPPORT SECTION
ACCIDENT INVESTIGATION UNIT

FINAL REPORT

THREE-DIMENSIONAL ANALYSIS EQUIPMENT FOR THE MULTIDISCIPLINARY ACCIDENT INVESTIGATION TEAM (3D MAIT)

PROJECT NUMBER PT0621

MAY 2008

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KEY PERSONNEL*

Key California Highway Patrol personnel involved in the project included:

Executive Management:

M. L. Brown, Commissioner
J. A. Farrow, Deputy Commissioner
K. P. Green, Assistant Commissioner, Staff
Arthur Anderson, Assistant Commissioner, Field

Project Staff:

<u>Project Director</u>
J. E. McLaughin, Chief
Planning and Analysis Division

<u>Project Managers</u>
S. J. Vaughn, Chief
Enforcement Services Division
D. Fox, Lieutenant
Field Support Section

<u>Project Coordinator</u>
Heath Scribner, Officer
Julie Green, Associate Governmental Program Analyst
Field Support Section

<u>Grant Coordinator</u>
D. West, Associate Governmental Program Analyst
Grants Management Unit

*Personnel are listed as they were assigned on the project ending date of March 31, 2008

CREDITS

This project is part of the California Traffic Safety Program and was made possible through the support of the California Office of Traffic Safety (OTS), the national Highway Traffic Safety Administration, and the State of California.

Personnel responsible for successful project completion included C. J. Murphy, Director, OTS; M. L. Brown, Commissioner, California Highway Patrol (CHP); K. P. Green, Assistant Commissioner, Staff, CHP; Arthur Anderson, Assistant Commissioner, Field, CHP; Chief S. J. Vaughn, Commander, Enforcement Services Division, CHP; Lieutenant D. Fox, Field Support Section, CHP; D. West, Grants Management Unit, CHP; and K. Carroll, Regional Coordinator, OTS.

DISCLAIMER

The opinions, findings, and conclusions expressed in this publication are those of the author and not necessarily those of the State of California, the National Highway Traffic Safety Administration, or the Federal Highway Administration.

CALIFORNIA

THREE-DIMENSIONAL ANALYSIS EQUIPMENT FOR THE MULTIDISCIPLINARY ACCIDENT INVESTIGATION TEAM (3D-MAIT)

PROGRAM AREA(S) Traffic Collisions	**PROJECT CHARACTERISTICS** Utilize 3D Laser Scanner Technology
TYPE OF JURISDICTION State of California	
TARGETED POPULATIONS General Population	**JURISDICTION SIZE** 37 Million Residents

PROBLEM IDENTIFICATION

Due to the in-depth nature of MAIT investigations, a roadway can be blocked for an extended period of time, significantly affecting traffic control. Roadway closures cause restricted traffic flow and result in traffic backlogs. Frequently, motorists approaching a traffic jam at normal freeway speeds of approximately 65 mph fail to observe the stop-and-go traffic ahead in time to react, resulting in secondary collisions.

Due to the detrimental effects prolonged road closures have on traffic safety, the California Highway Patrol (CHP) has determined that the old two-dimensional Total Station Survey System (TSSS-2D) investigative equipment still in use, purchased through the Office of Traffic Safety Grant PT9970 – MAIT Program Enhancement, is no longer the equipment most conducive to ensuring traffic safety. Additionally, the 2D equipment was completely depreciated by September 2005.

A quality investigation starts with the thorough and accurate collection of all evidence available at the scene. Any attempt to perform an analysis based on incomplete or inaccurate data can only result in inaccurate conclusions. The old TSSS-2D equipment collects an average of 200 to 300 2D evidence points in approximately 3.5 hours. The 3D laser scanner is capable of collecting 1,000,000 three-dimensional evidence points in 15 minutes.

PROJECT GOALS

1. To increase the number of collision evidence points utilizing the 3D laser scanner by 399,900 percent by December 31, 2007. *Result:* Accomplished. An average of 9,507,186.88 evidence points were collected for each use of the scanner. This is a 3.8 million percent increase.

2. To decrease the average time spent collecting collision evidence points from 3.5 hours to 15 minutes per 1,000,000 evidence points by December 31, 2007. *Result:* Not Accomplished. The average time decreased to 24.6 minutes to scan one million evidence points, which is an 88 percent reduction.

PROJECT OBJECTIVES

1. To develop an operational plan establishing the policies and procedures for project implementation by December 31, 2005. *Result:* Accomplished. An operational plan was developed on January 2, 2006, and was forwarded to Grants Management Unit.

2. To procure six 3D laser scanning and modeling systems, associated hardware, software, and computer workstations by June 30, 2007. *Result:* Accomplished. Five 3D laser scanning and modeling systems, associated hardware, software, and computer workstations were received on September 29, 2006. On March 9, 2007, approval for a sixth scanner was obtained and Field Support Section (FSS) received the sixth scanner on October 9, 2007.

3. To deploy all equipment to the six MAITs by September 30, 2007.
***Result:* Accomplished.** The five MAITs received all the equipment by January 22, 2007. Central Division MAIT received their equipment on October 24, 2006. Inland and Southern Division MAITs received their equipment on December 18, 2006. Northern and Valley Division MAITs received their equipment on January 22, 2007. The sixth scanner was received nine days past the due date set by Objective 3. FSS received their scanner on October 9, 2007. However, the procurement of the sixth scanner was not in the original Project Objectives. Approval for the sixth scanner was obtained on March 9, 2007.

4. To train at least 22 MAIT members and two Field Support Section (FSS) personnel in the use of the 3D laser system, associated hardware, software, and computer systems by December 31, 2007. *Result:* Accomplished. The 22 MAIT members and two FSS personnel received training in the use of the 3D laser system, associated hardware, software, and computer systems by January 22, 2007. Two FSS personnel and three Central Division MAIT members received their training on October 24, 2006. Five Inland Division MAIT members and four Southern Division MAIT members received their training on December 18, 2006. Four Northern Division MAIT members and six Valley Division MAIT members received their training on January 22, 2007.

5. To provide annual software updates to MAIT members and FSS personnel by December 31, 2007. *Result:* Not Applicable. Completion of this objective is contingent upon training and distribution of the project related equipment and supplies. FSS has obtained the equipment and completed the training. No software updates were available during the Operations Phase of the grant. After the grant ends, software updates will be completed as they become available.

STRATEGIES AND ACTIVITIES

The utilization of the 3D laser scanners will not only decrease the time in the collection of collision evidence points, it will increase the number of evidence points collected at the scene. This will provide the MAITs with more information than they were able to obtain in the past. This will also decrease the amount of time the roadway will need to be closed due to a major traffic collision.

RESULTS

The Operations Phase of the project ended as planned on December 31, 2007, and the results were excellent. Of the project's five objectives, four were accomplished on schedule. Objective # 5 (to provide software updates to MAIT members and FSS personnel by December 31, 2007) was not applicable. No software updates were available during the Operations Phase of the grant. After the grant ends, software updates will be completed as they become available.

During the project, the 3D laser scanners were utilized 45 times. In the 45 scans, the average number of evidence points collected per scan was 9,507,185.88 evidence points. At the theoretical maximum scan rate of 3.6 million points per hour, the new 3D laser scanners could complete this scan in approximately two hours and 39 minutes. The old 2D system would require over 12 years to accomplish the same scan.

With the continued use of the 3D laser scanner the MAITs will be begin to utilize the scanner to its full potential. With the familiarity they obtain while using the scanner, the time spent "on scene" at a traffic collision will decrease.

FUNDING
Granted: $1,378,040.14
Expended: $1,378,040.14

CONTACT
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THREE-DIMENSIONAL ANALYSIS EQUIPMENT FOR THE MULTIDISCIPLINARY ACCIDENT INVESTIGATION TEAMS (3D-MAIT)

INTRODUCTION

Effective October 1, 2005, and continuing through March 31, 2008, the California Highway Patrol (CHP) was granted $1,304,800 by the California Office of Traffic Safety (OTS) to conduct a project entitled Three-Dimensional Analysis Equipment for the Multidisciplinary Accident Investigation Teams (3D-MAIT), project number PT0621. This project focused on providing CHP MAITs with the acquisition, deployment, training and support for 3D laser technology to augment and expedite MAIT collision investigations. The MAITs have received the equipment and training and are currently utilizing the 3D laser technology in the field. The equipment previously used collects 250 two-dimensional evidence points in 3.5 hours. The 3D laser equipment is capable of collecting 1,000,000 three-dimensional evidence points in 15 minutes. This report was prepared in accordance with the PT0621 Project Agreement established between the CHP and OTS. The Project Agreement is contained in Annex A.

The original grant was for the procurement of five 3D laser scanners. Once the five scanners were procured, a request was submitted for the procurement of a sixth scanner. On March 9, 2007, the procurement of the sixth scanner was approved and the original grant was revised from five 3D scanners to six 3D scanners. The grant's funding was updated to $1,378,040.14 to cover the cost of the sixth scanner. The dates listed in the Project Objectives below were set regarding the original five 3D scanners. The sixth scanner is currently in use by headquarters MAIT for training purposes and to augment Valley and Golden Gate Division MAITs.

BACKGROUND

Motor vehicle collisions involving occupants, motorcyclists, bicyclists, and pedestrians are the leading cause of traumatic death for children and adults of all ages. With the intent of saving lives and reducing injuries, the CHP established the MAITs. The MAITs attempt to use information about identified causation factors to prevent recurrence of similar collisions.

However, due to the in-depth nature of MAIT investigations, a roadway can be blocked for an extended period of time, significantly affecting traffic control. Roadway closures cause restricted traffic flow and result in traffic backlogs. One of the most dangerous portions of a traffic backlog or "jam" is the tail end furthest from the blockage. Frequently, motorists approaching a traffic jam at normal freeway speeds of approximately 65 mph fail to observe the stop-and-go traffic ahead in time to react, resulting in a secondary collision. Additionally, the longer a road remains closed, the longer the resulting traffic jam becomes. Driver subject to extended periods of stop-and-go traffic frequently experience agitation and boredom, which then manifest in distracted driving behaviors. Distracted driving is known to be a causative factor in collisions.

Not only are secondary collisions likely to occur in those traffic jams resulting from road closures, traffic safety is also negatively impacted when patrol officers must be removed from enforcement duties to assist in traffic control during a collision investigation's road closure. Updating the MAIT equipment will decrease the duration of road closures for MAIT collision investigations by half, which logically suggests that fewer secondary collisions would occur. When road closure durations are shortened, patrol officers can be released from providing traffic control to resume their enforcement duties sooner. It has long been established that traffic enforcement saves lives.

Due to the detrimental effects prolonged road closures have on traffic safety, the CHP has determined that the old two-dimensional Total Station Survey System (TSSS-2D) investigative equipment still in use, purchased through the Office of Traffic Safety project PT9970 – MAIT Program Enhancement, is no longer the equipment most conducive to ensuring traffic safety. Additionally, the 2D equipment was completely depreciated by September 2005.

A quality investigation starts with the thorough and accurate collection of all evidence available at the scene. Any attempt to perform an analysis based on incomplete or inaccurate data can only result in inaccurate conclusions. The old TSSS-2D equipment collects an average of 200 to 300 2D evidence points in approximately 3.5 hours. The 3D laser scanner is capable of collecting 1,000,000 three-dimensional evidence points in 15 minutes (or 3.6 million points per hour).

PROJECT GOALS

Goal 1: To increase the effectiveness of CHP MAITs by increasing the number of collision evidence points collected during collision investigations in which a 3D Laser System is utilized, by 399,900 percent from the current collection equipment's capability of 250 data collection points per collision investigation to 1,000,000 points per investigation by December 31, 2007.

Result: Accomplished. All six MAITs have now received their equipment and training. The number of points collected per investigation will vary widely based on the size of the scene scanned and the quality of the scan itself. During the project, the 3D laser scanners were utilized 45 times. In the 45 scans, the average number of evidence points collected per scan was 9,507,185.88 evidence points. With the two-dimensional equipment previously used, 250 evidence points were collected per investigation. This equals a 3.8 million percent increase in the number of points scanned per investigation.

Goal 2: To increase the efficiency of the CHP MAITs by decreasing the average time spent collecting collision evidence points during an investigation by 93 percent from the 2001 through

2003 three-year average of 3.5 hours using the old equipment to 15 minutes using the 3D Laser System by December 31, 2007.

Result: Not Accomplished. Although the 93 percent reduction was not met, the progress toward this goal was hugely successful. The 45 scans took an average of 3.9 hours to complete. This equates to an average decrease of 88 percent in the time required to scan one million evidence points. Goals 1 and 2 are interrelated in that the number of data points collected to achieve goal 1 directly affects the time required to complete the scan which is measured in goal 2. To adjust for this, the goal is measured in the time required to scan the one million points targeted in goal 1, and not the time required to complete the entire scan. The time spent collecting points per investigation will vary widely based on the size of the scene scanned and the quality of the scan itself. In theory, this machine is capable of scanning one million points in 15 minutes. However, many, if not most, MAIT investigations will require considerably more evidence points, requiring more time. However, once the MAITs become proficient with the hardware, the times should decrease. Although there is no empirical evidence, informal reports from MAITs indicate that while using the new 3D scanners, average "on scene" time has been reduced by 30 to 50 percent.

PROJECT OBJECTIVES

Objective 1: To develop an operational plan establishing the policies and procedures for project implementation by December 31, 2005.

Result: Accomplished. An operational plan was developed on January 2, 2006, and was forwarded to Grants Management Unit (GMU).

Objective 2: To procure six 3D laser scanning and modeling systems, associated hardware, software, and computer workstations by June 30, 2007.

Result: Accomplished. Five 3D laser scanning and modeling systems, associated hardware, software, and computer workstations were received on September 29, 2006. On March 9, 2007, approval for a sixth scanner was obtained and Field Services Section (FSS) received the sixth scanner on October 9, 2007.

Objective 3: To deploy all equipment to the six MAITs by September 30, 2007.

Result: Accomplished. Five MAITs received all the equipment by January 22, 2007. Central Division MAIT received their equipment on October 24, 2006. Inland and Southern Division MAITs received their equipment on December 18, 2006. Northern and Valley Division MAITs received their equipment on January 22, 2007. The sixth scanner was received nine days past the due date set by Objective 3. FSS received their scanner on October 9, 2007; however, the procurement of the sixth scanner was not in the original Project Objectives. Approval for the sixth scanner was obtained on March 9, 2007.

Objective 4: To train at least 22 MAIT members and two Field Support Section (FSS) personnel in the use of the 3D laser system, associated hardware, software, and computer systems by December 31, 2007.

Result: Accomplished. The 22 MAIT members and two FSS personnel received training in the use of the 3D laser system, associated hardware, software, and computer systems by January 22, 2007. Two FSS personnel and three Central Division MAIT members received their training on October 24, 2006. Five Inland Division MAIT members and four Southern Division MAIT members received their training on December 18, 2006. Four Northern Division MAIT members and six Valley Division MAIT members received their training on January 22, 2007.

Objective 5: To provide annual software updates to MAIT members and FSS personnel by December 31, 2007.

Result: Not applicable. Completion of this objective is contingent upon receipt of project related equipment and the availability of software updates. FSS has obtained the equipment however, as of the grant ending date, no software updates were available. Software updates will be completed as they become available.

METHODOLOGY/CHRONOLOGY

The 30-month traffic safety project specifically tailored to collision investigations was conducted. The project was completed in four phases: 1) Program Preparation, 2) Program Operations, 3) Data Gathering and Reporting, and 4) Final Report and Executive Summary.

[-----Preparation-----] [----------Program Operations----------]
Oct 2005 – Dec 2005 Jan 2006 – Dec 2007

[-----------------------Data Gathering and Reporting-----------------------] [-----Final Report-----]
Oct 2005 – Mar 2008 Apr 2008 – May 2008

The following table presents the project methodology as outlined in the Project Agreement, as well as the actual project chronology.

METHODOLOGY OUTLINED IN PROJECT AGREEMENT	*ACTUAL PROJECT CHRONOLOGY*
Phase I – Program Preparation **October 1, 2005, through December 31, 2005**	
Tasks to be accomplished:	**Tasks accomplished:**
All necessary preparatory actions will be accomplished to ensure a prompt and smooth transition into the Program Operations Phase. Preparatory actions include the following:	
• Developing the operational plan by December 31, 2005, and promptly issuing the plan to affected commands.	• PT0621 Three-Dimensional Analysis Equipment for the Multidisciplinary Accident Investigation Team (3D-MAIT) Operational Plan was developed on January 2, 2006, and forwarded to GMU.
• Upon receipt of OTS' official funding authorization, selecting six 3D laser scanning and modeling systems, associated hardware, software, and computer workstations and itemizing them on a purchase requisition for submission through the Office of Primary Interest's (OPI) Division to the Grants Management Unit (GMU) for approval. Items to be requisitioned are listed in the Schedule B (Budget Estimate) and Schedule B-1 (Budget Narrative).	• FSS selected the Leica ScanStation system with associated hardware, software, and computer workstations. Purchase requisitions were submitted through the Grants Management Unit. Items were listed in the Schedule B (Budget Estimate) and Schedule B-1 (Budget Narrative).
• Accomplishing any other preparations necessary for timely project implementation.	• FSS did accomplish all preparations for the purchase of the sixth scanner. All preparations were completed in a timely manner.
Phase II – Program Operations **January 1, 2006, through December 31, 2007**	
Tasks to be accomplished:	**Tasks accomplished:**
Project related operations/activities will be completed and results will be provided to OTS in Quarterly Progress Reports. Activities include the following:	
• Receiving and deploying all equipment to the six MAITs by September 30, 2007.	• FSS received the equipment and deployed it to five MAITs by January 22, 2007, prior to September 30, 2007, due date. The sixth scanner was approved on March 9, received

	on October 9, 2007, nine days past the due date. Procurement of the sixth scanner was not in the original Project Objectives.
• Training up to 30 MAIT members and two FSS personnel in the use of the 3D laser system, associated hardware and software, and computer workstations by December 31, 2007.	• Twenty-two MAIT members and two FSS personnel were trained in the use of the 3D laser system, associated hardware and software, and computer workstations by January 22, 2007, prior to the December 31, 2007, due date.
• Providing annual software updates to MAIT members and FSS personnel by December 31, 2007.	• No software updates were available during the Operations Phase of the grant. After the grant ends, software updates will be completed as they become available.
Phase III- Data Gathering and Reporting Throughout Project Period	
Tasks to be accomplished:	**Tasks accomplished:**
Data gathering, analysis, and reporting will be conducted throughout the project period. Post-operations activities will be completed. Activities include the following:	
• Data relating to the project goals and objectives will be collected, analyzed, and incorporated into Quarterly Performance Reports (QPR). QPRs for quarters ending September 30 will include year-to-date comparisons of goals and objectives.	• All statistical information was compiled in QPRs, then forwarded to GMU for approval.
• These reports will compare actual project accomplishments with the planned accomplishments. They will include information concerning changes made by the Project Director in planning and guiding the project efforts.	• All reports were completed according to specified guidelines including all changes made by the Project Director.
• Reports shall be completed in accordance with OTS requirements specified in the Grant Program Manual, Volume II, Chapter 7, and submitted in compliance with the signed Acceptance of Conditions and Certifications (OTS-33) included with the agreement.	• All reports were completed according to specified guidelines including all changes made by the Project Director.

Phase IV – Final Report and Executive Summary April 1, 2008	
Tasks to be accomplished:	**Tasks accomplished:**
Begin the Final Report and Executive Summary in accordance with OTS requirements specified in the Grant Program Manual, Chapter 7. Both will be submitted to GMU within 30 days after the grant ends and to OTS within 60 days after the grant ends. One final report and executive summary will be prepared and submitted to OTS by the due date of May 31, 2008.	
• The OPI will prepare the Final Report detailing project accomplishments.	• A Final Report was prepared.

PROBLEMS

The project was effectively implemented and encountered only minor difficulties, which were promptly addressed.

The one problem which affected the Project Goals was that Goals 1 and 2 are inversely related. Overachieving in Goal 1 resulted in underachieving in Goal 2. To adjust for this, Goal 2 is measured in the time required to scan the one million points targeted in Goal 1, and not the time required to complete the entire scan.

Another issue was confusion on the part of MAIT personnel as to how to properly measure the "time spent collecting collision evidence points during an investigation," as directed in Goal 2. Some recorded the entire "on scene" time, others recorded the set-up and scan time, and still others, just the scan time. MAITs were subsequently instructed to measure only scan time as a measure of Goal 2 effectiveness.

RESULTS

The Operations Phase of the project ended as planned on December 31, 2007, and the results were excellent. Of the project's five objectives, four were accomplished on schedule. Objective # 5 (to provide software updates to MAIT members and FSS personnel by December 31, 2007) was not applicable. No software updates were available during the life of the grant. After the grant ends, software updates will be completed as they become available.

During the project, the 3D laser scanners were utilized 45 times. In the 45 scans, the average number of evidence points collected per scan was 9,507,185.88 points. At the theoretical maximum scan rate of 3.6 million points per hour, the new 3D laser scanners could complete this scan in approximately two hours and 39 minutes. The old TSSS-2D would require over 12 years to accomplish the same scan. Although this is theoretical and does not include the myriad other duties performed by MAIT at a collision scene, it is indicative of the tremendous advantage this equipment provides. This grant has resulted in an actual "on scene" time reduction of 30 to 50 percent accompanied by unsurpassed accuracy and quality in collision scene reconstruction.

COST EFFECTIVENESS

BUDGET CATEGORY	AMOUNT BUDGETED	AMOUNT EXPENDED	BALANCE	PERCENT REMAINING
Travel Expense	$21,604.84	$21,604.84	$0.00	0.00%
Equipment	$1,222,356.58	$1,222,356.58	$0.00	0.00%
Other Direct Costs	$134,078.72	$134,078.72	$0.00	0.00%
Total	$1,378,040.14	$1,378,040.14	$0.00	0.00%

As indicated in the above table, grant activities were accomplished within allocated budget. The budget information above was obtained from the Expenditure Ledger prepared by the Fiscal Management Section.

The project was more than cost effective when we compare the amount of on scene time it takes using the old TSSS-2D system to collect collision evidence points compared to the amount of time it takes using the new 3D laser scanner. On average, it takes 3.5 hours to collect the points using the TSSS-2D. The 3D laser scanner at this time is reducing the 3.5 hours by 30 to 50 percent. Using the 30 percent, the time it takes to collect the points on scene with the 3D laser scanner is 2.45 hours, which is 1.05 hours faster. As the MAITs become proficient with the hardware, the on scene time will decrease even more. The per hour cost of traffic congestion in the State of California, based on a Caltrans study in 2007, is $106,423. With the time saving per investigation of 1.05 hours, this equates to a traffic congestion relief savings of $111,744. During this project a total of 45 scans were completed, that is a time saving of 47.25 hours, which equates to a traffic congestion relief savings of $5,279,904. This amount shows this project has been more than cost effective.

RECOMMENDATIONS

It is recommended the MAITs continue to train on the 3D laser scanner and to use it more frequently in their investigations. With the continued use of the 3D laser scanner the MAITs will begin to utilize the scanner to its full potential. With the familiarity they obtain while using the scanner, the time spent "on scene" at a traffic collision will decrease.

The scanners have been such a success, FSS is in the process of attempting to procure two additional 3D laser scanners with alternate financial resources. The two additional scanners will be distributed to MAITs which have been recently reinstated and have come on line.

ANNEX A

PROJECT AGREEMENT

State of California

OFFICE OF TRAFFIC SAFETY GRANT AGREEMENT

PROJECT NUMBER
PT0621

PAGE 1 (To be completed by applicant Agency)

1. PROJECT TITLE

THREE-DIMENSIONAL ANALYSIS EQUIPMENT FOR THE MULTIDISCIPLINARY ACCIDENT INVESTIGATION TEAM (3D-MAIT)

2. NAME OF APPLICANT AGENCY

CALIFORNIA HIGHWAY PATROL

3. AGENCY UNIT TO HANDLE PROJECT

PLANNING AND ANALYSIS DIVISION

4. PROJECT PERIOD

Month – Day – Year

FROM: 10/01/05

TO: 03/31/08

5. PROJECT DESCRIPTION (Summarize the project plan covering activities that address the major goals and objectives in approximately 100 words. Space is limited to 6 lines.)

Incorporating new technology in collision investigative techniques will streamline collision investigations, which provide the basis for determining and preventing collision causation factors. This project provides California Highway Patrol MAITs with acquisition, deployment, training, and support for 3D laser technology to augment and expedite MAIT collision investigations. The equipment currently in use collects 200 to 300 two-dimensional evidence points in 3.5 hours. The proposed 3D laser equipment is capable of collecting 1,000,000 three-dimensional evidence points in 15 minutes.

6. FEDERAL FUNDS ALLOCATED UNDER THIS AGREEMENT SHALL NOT EXCEED $1,378,040.14

7. APPROVAL SIGNATURES

A. PROJECT DIRECTOR

NAME: J. E. MCLAUGHLIN PHONE: (916) 657-4098
TITLE: Chief FAX: (916) 657-4087

ADDRESS: 2555 First Avenue
Sacramento, CA 95818

E-MAIL: JMCLAUGHLIN@CHP.CA.GOV

(Signature) 11/28/07 (Date)

B. AUTHORIZING OFFICAL OF APPLICANT AGENCY

NAME: K. P. GREEN PHONE: (916) 657-7194
TITLE: Assistant Commissioner, Staff FAX: (916) 657-7324

ADDRESS: 2555 First Avenue
Sacramento, CA 95818

E-MAIL: KGREEN@CHP.CA.GOV

(Signature) 12/11/07 (Date)

C. FISCAL OR ACCOUNTING OFFICIAL

NAME: M. S. EPPS PHONE: (916) 375-2733
TITLE: Commander FAX: (916) 375-2752

ADDRESS: 860 Stillwater Road
West Sacramento, CA 95605-1649

E-MAIL: MSEPPS@CHP.CA.GOV

(Signature) 12/12/07 (Date)

D. OFFICE AUTHORIZED TO RECEIVE PAYMENTS

NAME: FISCAL MANAGEMENT SECTION

ADDRESS: P.O. Box 942900
Sacramento, CA 94298-2900

EFFECTIVE DATE OF AGREEMENT: 10/1/2007	**GRANTEE** CHP		**PROJECT NO.** PT0621		
8. Action No. 5 **Date:** 1/8/2008	**10. TYPE OF AGREEMENT**	**Initial** [ ]	**Revision** [ ]	**Cont.** [X]	
Revision No. 2 **Date:** 1/8/2008	FUND 402	PROGRAM PT	TASK NO. 3	F.Y. 2008	

9. Action Taken

Project continued in FY 2008. Unexpended 2007 HSP funds of $176,184.03 reobligated for expenditure in 2008.

2008 HSP grant funds of $0.00 obligated.

Total funds programmed remain unchanged.

State FY 2007-08
2700-001-0890 (171/07)

Catalog Federal Domestic Assistance No. 20.600

11. FUNDING DISPOSITION & STATUS

Fiscal Year	Amount
2005-06	1,182,351.27
2006-07	19,504.84
2007-08	176,184.03
Total	1,378,040.14
Obligated This Action	176,184.03
Previously Obligated	1,201,856.11
Total Amount Obligated	1,378,040.14
Amount Suspended	0.00
TOTAL FUNDS PROGRAMMED	1,378,040.14

12. BUDGET SUMMARY (From Schedule B Detail) - FISCAL YEAR GRANT PERIOD ENDING: 3/31/2008

COST CATEGORY	2008 GRANT PERIOD	2005-07 PRIOR GRANT	2005-08 TOTAL GRANT	TOTAL PROJECT BUDGET ESTIMATE
A. Personnel Costs	0.00	0.00	0.00	0.00
B. Travel Expenses	2,100.00	19,504.84	21,604.84	21,604.84
C. Contractual Services	0.00	0.00	0.00	0.00
D. Equipment	174,084.03	1,048,272.55	1,222,356.58	1,222,356.58
E. Other Direct Costs	0.00	134,078.72	134,078.72	134,078.72
F. Indirect Costs	0.00	0.00	0.00	0.00
TOTAL FEDERAL FUNDS	176,184.03	1,201,856.11	1,378,040.14	1,378,040.14

13. PROJECT APPROVAL & AUTHORIZATION TO EXPEND OBLIGATED FUNDS

A. APPROVAL RECOMMENDED BY

NAME: JULIE SCHILLING
TITLE: Regional Coordinator
PHONE: (916) 262-1755
E-MAIL: jschilling@ots.ca.gov
Office of Traffic Safety
7000 Franklin Blvd., Suite 440
Sacramento, CA 95823

Signature Julie Schilling

B. AGREEMENT & FUNDING AUTHORIZED BY

NAME: MICHELE MEADOWS
TITLE: Assistant Director of Operations

Office of Traffic Safety
7000 Franklin Blvd., Suite 440
Sacramento, CA 95823

Signature Michele Meadows

PROBLEM STATEMENT

Motor vehicle collisions involving occupants, motorcyclists, bicyclists, and pedestrians are the leading cause of traumatic death for children and adults of all ages. With the intent of saving lives and reducing injuries, the California Highway Patrol (CHP) established Multidisciplinary Accident Investigation Teams (MAITs). The MAITs attempt to use information about identified causation factors to prevent recurrence of similar collisions.

However, due to the in-depth nature of MAIT investigations, a roadway can be blocked for extended periods of time, significantly affecting traffic flow. Roadway closures cause restricted traffic flow and result in traffic backlogs. One of the most dangerous portions of a traffic backlog or "jam" is the tail end furthest from the blockage. Frequently, motorists approaching a traffic jam at normal freeway speeds of approximately 65 mph fail to observe the stop-and-go traffic ahead in time to react, resulting in a secondary collision. Additionally, the longer a road remains closed, the longer the resulting traffic jam becomes. Drivers subject to extended periods of stop-and-go traffic frequently experience agitation and boredom, which then manifest in distracted driving behaviors. Distracted driving is known to be a causative factor in collisions.

Not only are secondary collisions likely to occur in traffic jams resulting from road closures, traffic safety is also negatively impacted when patrol officers must be removed from enforcement duties to assist in traffic control during a collision investigation's road closure. Updating the MAIT equipment will decrease the duration of road closures for MAIT collision investigations by half, which logically suggests that fewer secondary collisions would occur. When road closure durations are shortened, patrol officers can be released from providing traffic control to resume their enforcement duties sooner. It has long been established that traffic enforcement saves lives.

Due to the detrimental affects prolonged road closures have on traffic safety, the CHP has determined that the old two-dimensional Total Station Survey System (TSSS-2D) investigative equipment still in use, purchased through the Office of Traffic Safety project PT9970 - MAIT Program Enhancement, is no longer the equipment most conducive to ensuring traffic safety. Additionally, the 2D equipment will be completely depreciated by September 2005.

A quality investigation starts with the thorough and accurate collection of all evidence available at the scene. Any attempt to perform an analysis based on incomplete or inaccurate data can only result in inaccurate conclusions. The old TSSS-2D equipment collects an average of 200 to 300 2D evidence points in approximately 3.5 hours. The 3D laser equipment is capable of collecting 1,000,000 3D evidence points in 15 minutes.

PERFORMANCE MEASURES

A. PROJECT GOALS

1. To increase the effectiveness of CHP's MAITs by increasing the number of collision evidence points collected during collision investigations in which a 3D Laser System is utilized, by 399,900 percent from the current collection equipment's capability of 250 data collection points per collision investigation to 1,000,000 points per investigation by December 31, 2007.

2. To increase the efficiency of the CHP's MAITs by decreasing the average time spent collecting collision evidence points during an investigation by 93 percent from the 2001 through 2003 three-year average of 3.5 hours using the old equipment to 15 minutes using the 3D Laser System by December 31, 2007.

B. PROJECT OBJECTIVES

1. To develop an operational plan establishing the policies and procedures for project implementation by December 31, 2005.

2. To procure six 3D laser scanning and modeling systems, associated hardware, software, and computer workstations by June 30, 2007.

3. To deploy all equipment to the six MAITs by September 30, 2007.

4. To train at least 22 MAIT members and two Field Support Section (FSS) personnel in the use of the 3D laser system, associated hardware and software, and computer systems by December 31, 2007.

5. To provide annual software updates to MAIT members and FSS personnel by December 31, 2007.

METHOD OF PROCEDURE

A 30-month traffic safety project specifically tailored to collision investigations will be conducted. The project will be completed in four phases: 1) Program Preparation, 2) Program Operations, 3) Data Gathering and Reporting, and 4) Final Report and Executive Summary.

[-----Preparation-----] [------------Program Operations----------]
Oct 2005 - Dec 2005 Jan 2006 - Dec 2007

[-------------------------Data Gathering and Reporting-----------------------] [-----Final Report-----]
Oct 2005 - Mar 2008 Apr 2008-May 2008

A. PHASE 1 – PROGRAM PREPARATION (October 1, 2005, through December 31, 2005)

All necessary preparatory actions will be accomplished to ensure a prompt and smooth transition into the Program Operations Phase. Preparatory actions include the following:

- Developing the operational plan by December 31, 2005, and promptly issuing the plan to affected commands.
- Upon receipt of OTS' official funding authorization, selecting five 3D laser scanning and modeling systems, associated hardware, software, and computer workstations and itemizing them on a purchase requisition for submission through the Office of Primary Interest's (OPI's) Division to the Grants Management Unit (GMU) for approval. Items to be requisitioned are listed in the Schedule B (Budget Estimate) and Schedule B-1 (Budget Narrative).
- Accomplishing any other preparations necessary for timely project implementation.

B. PHASE 2 – PROGRAM OPERATIONS (January 1, 2006, through December 31, 2007)

Project-related operations/activities will be completed and results will be provided to OTS in Quarterly Progress Reports. Activities include the following:

- Receiving and deploying all equipment to the four MAITs by September 30, 2007.
- Training up to 30 MAIT members and two FSS personnel in the use of the 3D laser system, associated hardware and software, and computer workstations by December 31, 2007.
- Providing annual software updates to MAIT members and FSS personnel by December 31, 2007.

C. PHASE 3 – DATA GATHERING AND REPORTING (Throughout Project Period)

Data gathering, analysis, and reporting will be conducted throughout the project period. Post-operations activities will be completed. Activities include the following:

- Data relating to the project goals and objectives will be collected, analyzed, and incorporated into Quarterly Performance Reports (QPRs). QPRs for quarters ending September 30 will include year-to-date comparisons of goals and objectives.
- These reports will compare actual project accomplishments with the planned accomplishments. They will include information concerning changes made by the Project Director in planning and guiding the project efforts.

- Reports shall be completed in accordance with OTS requirements specified in the Grant Program Manual, Volume II, Chapter 7, and submitted in compliance with the signed Acceptance of Conditions and Certifications (OTS-33) included with this agreement.

D. PHASE 4 – FINAL REPORT AND EXECUTIVE SUMMARY (April 1, 2008)

Begin the Final Report and Executive Summary in accordance with OTS requirements specified in the Grant Program Manual, Chapter 7. Both will be submitted to GMU within 30 days after the grant ends and to OTS within 60 days after the grant ends. One final report and executive summary will be prepared and submitted to OTS by the due date of May 31, 2008.

METHOD OF EVALUATION

Using the data compiled in Phase 3, the project manager will evaluate: (1) the extent to which the stated project goals and objectives were accomplished, (2) whether all activities outlined in the "Method of Procedure" were performed in accordance with the project agreement, and (3) the project's cost effectiveness.

ADMINISTRATIVE SUPPORT

This program has the full support of CHP Executive Management. Every effort will be made to continue the activities after the project's conclusion.

SCHEDULE B
PAGE 1
DETAILED BUDGET ESTIMATE

PROJECT NO.: PT 0621

COST CATEGORY	FISCAL YEAR (FY) ESTIMATES			TOTAL COST TO PROJECT
	FY-1 10/01/05 thru 09/30/06 Actual Costs	FY-2 10/01/06 thru 09/30/07 Actual Costs	FY-3 10/01/07 thru 03/31/08	
A. PERSONNEL COSTS				
Category Subtotal	**$0.00**	**$0.00**	**$0.00**	**$0.00**
B. TRAVEL EXPENSE				
In-State	$0.00	$19,504.84	$2,100.00	$21,604.84
Category Subtotal	**$0.00**	**$19,504.84**	**$2,100.00**	**$21,604.84**
C. CONTRACTUAL SERVICES				
Category Subtotal	**$0.00**	**$0.00**	**$0.00**	**$0.00**
D. EQUIPMENT				
(Incl. tax/delivery/set-up/etc., as applicable)				
1. 3D Laser Systems (6)	$1,020,890.37	$0.00	$174,084.03	$1,194,974.40
2. Desktop Computers (6)	27,382.18	0.00	0.00	27,382.18
Category Subtotal	**$1,048,272.55**	**$0.00**	**$174,084.03**	**$1,222,356.58**
E. OTHER DIRECT COSTS				
(Incl. sales tax, as applicable. See Sched. B-1.)				
1. Engineering Dynamics Software Suites (6)	$133,651.22	$0.00	$0.00	$133,651.22
2. Hardware Key for Ports (6)	427.50	0.00	0.00	427.50
Category Subtotal	**$134,078.72**	**$0.00**	**$0.00**	**$134,078.72**
F. INDIRECT COSTS				
Category Subtotal	**$0.00**	**$0.00**	**$0.00**	**$0.00**
PROJECT TOTAL	**$1,182,351.27**	**$19,504.84**	**$176,184.03**	**$1,378,040.14**

A. PERSONNEL COSTS

No funding is provided for personnel costs.

B. TRAVEL EXPENSE

In-state travel funding is provided for approximately 30 MAIT members (22 existing and eight anticipated new hires), the project coordinator, and an assistant to attend training in the proper use of the equipment and software provided for in this grant. The training will consist of a week-long session for 32 people. Given the distribution of MAIT throughout the state, seven of the 32 attendees are expected to live near the training location, which has yet to be determined. Travel provides for round-trip airfare, lodging, transportation, and per diem for 25 MAIT members traveling to the training from out of the area.

Travel funding provides for the project coordinator and supervisor to attend five off-site meetings and presentations associated with the three-dimensional (3D) laser system, two locally and three out of the area. The travel funding for off-site meetings covers two attendees for a total of ten 24-hour periods of travel, to include lodging, per diem, and transportation to the meetings in accordance with state regulations.

Funding also provides for the project coordinator and an assistant to attend up to three traffic safety conferences such as Office of Traffic Safety Conference, the Annual Traffic Safety Conference, and the Police Traffic Services Conference. The travel funding provides for round-trip airfare, conference registration, lodging, transportation, and per diem in accordance with state regulations.

C. CONTRACTUAL SERVICES

No funding is provided for contractual services.

D. EQUIPMENT

Funds provide for the purchase of the 3D laser technology, accessories, licenses, warranties, training, installation, and shipping.

1. **3D Laser Scanning System.** Funding provides for six 3D Laser Scanning Systems. Due to the limited number of processing stations, the 3D laser technology will augment, rather than replace, the existing two-dimensional Robotic Total Station Survey System (2D-RTSSS). The six 3D Laser Scanning Systems will be deployed to CHP's six MAITs and used to collect evidence and reconstruct collision causation factors at collision sites as the preferred alternative to the existing 2D-RTSSS. The 3D Laser System records specific reference points which are recorded in an on-board data collector. The information is then downloaded to one of the six computers described below, with which highly accurate scene diagrams are drawn.

2. **Desktop Computers.** The six project-funded computers will be distributed to CHP's six MAITs, where they will run the 3D Laser System's specialized software programs. These desktop computers' highly specialized design allows them to handle multiple complex programs of several megabytes (MB) each simultaneously. An administrative desktop computer would not have the capacity to run the Engineering Dynamics Software Suite, nor to handle multiple files of several MB each in creating the 3D "movies" for collision simulations as the six project-funded desktop computers do. Each collision simulation file contains gigabytes of information.

E. OTHER DIRECT COSTS

Funding provides for the purchase of six Engineering Dynamics Software Suites. The applicable sales tax rate for the point of delivery has been included in the estimated cost of each affected item described. The software suites are comprised of the following components:

1. **Engineering Dynamics Software Suite x 6.**
   a) Vehicle Simulation Files Software. Used to set up human, vehicle, and environment models; set up events; visualize results; and create simulation movie files.
   b) Vehicle Database Software. This is a database containing over 1,000 unique vehicle datasets including vehicle body mesh and performance parameters.
   c) 3D Dynamic Simulation Software. This software is required for 3D simulation of resulting collisions, given programmable input variables for one or more vehicles and related drivers. The software also takes environmental factors into account when creating the simulation. The six hardware keys apply to only the 3D Simulation software.
   d) Reconstruction Software. This software is used to reconstruct single and two vehicle collisions.
   e) 2.5D Simulation Software. This provides 2.5D simulation analysis for studying complex collisions including simultaneous multiple vehicle collisions and articulated vehicle collisions.
   f) Vehicle Articulation Software. This software allows for the study of articulated multi-vehicle trains of virtually any vehicle/trailer configuration.

2. **Hardware Key for Ports.** This is a hardware key with parallel port or USB port compatibility. The six turn keys apply to the 3D Simulation Software only.

F. INDIRECT COSTS

Indirect costs are included as an agency contribution.

G. PROGRAM INCOME

No program income will be generated as a result of this project.

STATE OF CALIFORNIA • OFFICE OF TRAFFIC SAFETY

ACCEPTANCE OF CONDITIONS AND CERTIFICATIONS

OTS-33 (Rev. 5/05)

APPLICANT AGENCY	OTS PROJECT NUMBER
California Highway Patrol	**PT0621**

The following are included herein and constitute a part of this Agreement:

1. OTS-38 – Page 1	5. Schedule C – Quarterly Evaluation Data (when required)
2. Schedule A – Project Description	6. OTS-33 – Acceptance of Conditions and Certifications
3. Schedule B – Detailed Budget Estimate	7. General Terms, Conditions, and Certifications (OTS Grant Program Manual, Volume II, Chapter 6. Volume II, available on-line at www.ots.ca.gov)
4. Schedule B-1 – Budget Narrative	

TERMS AND CONDITIONS

It is understood and agreed by the Project Director and Authorizing Official that any grant received as a result of this Agreement is subject to all federal and state regulations governing grants and to those controls expressed in the California Traffic Grant Program Manuals which include, but are not limited to:

REPORTS

1. Quarterly Performance Reports and Reimbursement Claims must be submitted by the Project Director to the Office of Traffic Safety by January 31, April 30, July 31, and October 31, during each year of project operation.

2. OTS will withhold or disallow grant payments, reduce or terminate grant funds, and/or deny future grant funding anytime a grantee fails to comply with any term or condition of the grant contract or program guidelines (**Volume II, Chapter 3.13**). This may include, but is not limited to, the following:
   - Failure to submit acceptable and timely reimbursement claims.
   - Failure to submit acceptable and timely quarterly performance reports; and
   - Failure to submit an acceptable and timely Schedule C, Quarterly Evaluation Data (OTS-38g, applies only when a Schedule C has been required.)

3. By October 31, "continuing" projects must submit a September 30 claim and a written justification to support carrying forward prior year unexpended funds. September 30 claims and written justifications, supporting the carrying forward of prior year unexpended funds, submitted after November 30, will not be processed. The prior claim (i.e., June 30) will be considered the year-end claim in order to close out the federal fiscal year ending September 30. In addition, prior year unexpended funds will be deobligated and allocated to new projects.

SUBCONTRACTS

4. Consultants and/or subcontractors shall be selected in accordance with the grantee agency procurement policies and procedures in order to comply with the terms of this agreement and in accordance with the OTS Grant Program Manual, Volume II Chapter 6 Procurement & Contract Administration, and Exhibit 6-A General Terms, Conditions, and Certifications.

   A fully executed copy of the consultant contract or subcontract and completed Contractual Services Checklist & Questionnaire, OTS 85 shall be submitted to OTS for inclusion in the official project file prior to request for reimbursement.

   The grantee, consultant, contractor and/or subcontractor are subject to all conditions and certifications of the Project Agreement and 49 CFR Part 18, and/or CFR Part 19 whichever is applicable.

   Services shall be provided subsequent to final execution and signature by both parties to the contract and the work shall be consistent with the start and end dates identified in the Project Agreement. The State is not obligated to make any payment under any agreement prior to final execution or outside the terms of the contract period. Contractor/Applicant Agency expenditures incurred prior to final execution are taken at the risk of that Contractor/Applicant Agency and will be considered unallowable if that agreement/contract is not executed.

AVAILABILITY OF FUNDS

5. If, during the term of the grant award, federal funds become reduced or eliminated, OTS may immediately terminate or reduce the grant award upon written notice to the project director.

REVISIONS

6. Project revisions are allowed in accordance with the guidelines detailed in the OTS Volume II, Chapter 3.8 and the revision examples provided in Chapter 3.9. All appropriate documentation required to request a project revision requiring OTS approval (i.e., budget category increases, etc.) must be submitted to OTS.

7. No alteration or variation of the terms of this Agreement shall be valid unless made in writing and signed by the parties hereto, and no oral understanding or agreement not incorporated herein shall be binding on any of the parties hereto.

8. Additional terms and conditions identified in the OTS **Grant Program Manual, Volume II, Chapter 6, General Terms, Conditions, and Certifications (Exhibit 6-A)**, are incorporated herein by reference and made a part of this document.

ENFORCEMENT AGENCIES ONLY:

9. Full time personnel funded under this project shall be dedicated in total to traffic law enforcement.

   EXCEPT:
   - In the case of a criminal offense committed in the officer's presence.
   - In the case of response to an officer in distress.
   - In the case of a riot where all available personnel must be committed.

10. Equipment funded under this project is subject to the same requirements as No. 9 above.

We, the officials named below, hereby swear that we are duly authorized legally, to bind the contractor or grant recipient to the above described terms and conditions. Executed on the date and in the county below, and is made under penalty of perjury under the laws of the State of California.

PROJECT DIRECTOR'S NAME B. G. STANTON	EXECUTED IN THE COUNTY OF Sacramento
Project Director's Signature Bonita G Stanton	DATE EXECUTED 10-17-05
TITLE Assistant Chief	
AUTHORIZING OFFICIAL'S NAME K. P. GREEN	EXECUTED IN THE COUNTY OF Sacramento
AUTHORIZING OFFICIAL'S SIGNATURE	DATE EXECUTED 11/16/05
TITLE Assistant Commissioner, Staff	

ANNEX B

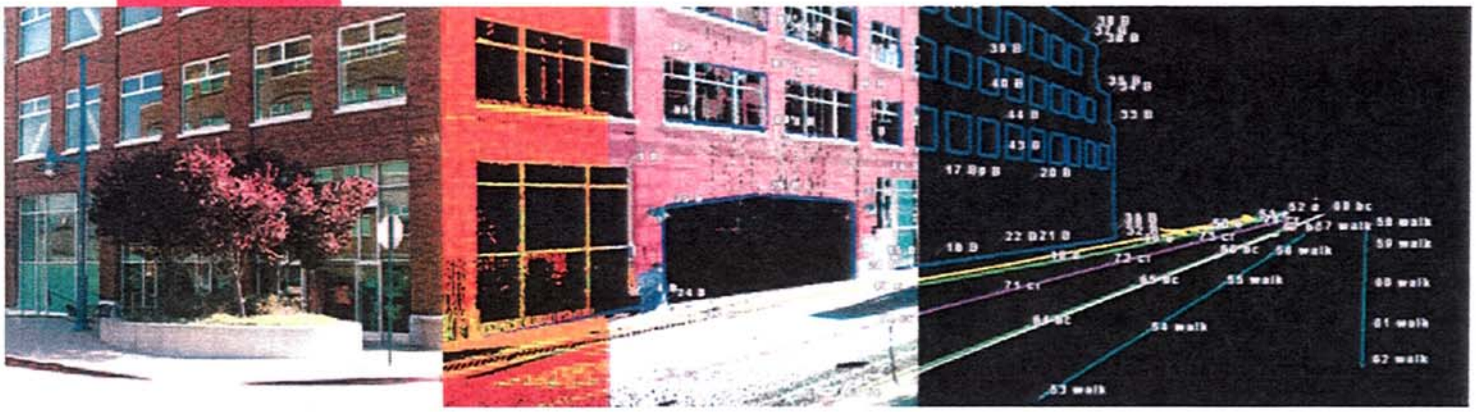
LEICA GEOSYSTEMS SCANSTATION BROCHURE AND SPECIFICATIONS

Leica ScanStation

A new level of versatility in laser scanners

- when it has to be **right**

Leica Geosystems



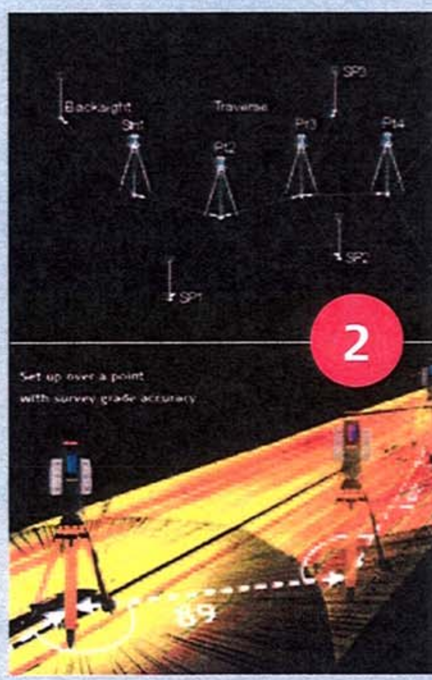
Leica ScanStation

A new class of laser scanner

Scan with the freedom, ease-of-use and accuracy of a total station. Leica ScanStation represents a new class of laser scanner and a new level of versatility in laser scanning.

Why does Leica ScanStation represent a "new category" of scanner?

With the integration of dual-axis (tilt) compensation into the industry's leading laser scanner platform, ScanStation sets a new industry standard for versatility, productivity, and ease-of-use. Leica ScanStation is the first scanner with all 4 of these fundamental total station features in 1 scanner:



1. Full Field-of-View

Scanners capture ceilings, undersides of bridges, elevated pipe racks, tall facades, columns and towers. The field-of-view of a total station isn't restricted. Surveyors and other professionals shouldn't have to settle for a scanner with a restricted field-of-view, either.

2. Survey-grade dual-axis (tilt) compensation

For greater flexibility and productivity, ScanStation users can traverse from control and resection with survey-grade accuracy. The same compensator as in Leica total stations also lets users scan with fewer targets and stakeout if needed.

3. Survey-grade point accuracy

While some scanners require "averaging" to approach survey-grade accuracy, ScanStation delivers survey-grade accuracy for each individual measurement. ScanStation's ultra-fine point spacing at long range also lets users take optimal advantage of scan targets for unsurpassed project control and registration accuracy.

Leica ScanStation

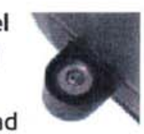
In addition to its four critical total station features, Leica ScanStation offers a host of other advantages for surveyor friendliness, productivity and versatility. The bottom line is the ability to apply High-Definition Surveying™ (HDS™) even more profitably for everyday as-built and topographic surveys.

- **High-speed pulsed laser**
  Fast scanning and excellent, useful distance
- **X-function compatibility**
  Interoperable with Leica System 1200

WORKING TOGETHER
X FUNCTION integrated
LEICA SYSTEM 1200

- **Integrated dual-axis compensator**
  For survey-grade traversing

- **Integrated high-resolution camera**
  For faster scene selection and compelling, automatically rectified photo overlays
- **Advanced scripting controls**
  SmartScan™ firmware allows automated sequencing of scans and unattended operation
- **HI marks, tribrach mount, carry handle, and QuickScan button**
  Standard procedures and accessories make ScanStation easy to learn and use
- **External bubble level**
  Conveniently located on the back side of the moving scan head



4. Excellent practical, useful distance

ScanStation's range of approx. 300 m for 90 % reflectivity surfaces and 134 m for 18 % reflectivity surfaces addresses the vast majority of typical sites for reflectorless instruments. ScanStation's high accuracy, narrow beam, and fine-scanning capability provide excellent useful range for achieving survey-grade results.

Key Leica ScanStation Performance Specifications	
Instrument type	Pulsed, dual-axis compensated, high-speed laser scanner, with survey-grade accuracy, range, and field-of-view
User interface	Notebook or Tablet PC
Camera	Integrated high-resolution digital camera
Accuracy of single measurement	Position* 6 mm Distance* 4 mm Angle (horizontal/vertical) 60 µrad/60 µrad (3.8 mgon/3.8 mgon) **
Laser spot size	From 0 – 50 m: 4 mm (FWHH-based); 6 mm (Gaussian-based)
Modeled surface precision/noise	2 mm **
Target acquisition	2 mm std. deviation
Dual-axis compensator	Resolution 1", dynamic range +/- 5'
Data integrity monitoring	Periodic self-check during operation and start-up
Laser scanning system	Range 300 m @90 %; 134 m @18 % albedo Scan rate Maximum instantaneous: up to 4,000 points/sec Average: dependent on specific scan density and field-of-view Scan density 1.2 mm max. through full range; fully selectable horizontal & vertical point spacing
Laser class	3R (IEC-60825-1), visible green
Lighting	Fully operational between bright sunlight and complete darkness
Power supply	36 V; AC or DC; hot swappable
Power consumption	<80 W, avg.
Turret rotation	Direct drive, brushless; cable-free
Temperature	Operation: 0° C to + 40° C; Storage: - 25° C to + 65° C
Data exchange	Import Cyclone native IMP object database format, Cyclone Object Exchange (COE) format, ASCII point data (XYZ, SVY, PTS, PTX, TXT); Leica X-function DBX, LandXML, ZFS, ZFC, 3DD Export ASCII point data (XYZ, SVY, PTS, PTX, TXT); DXF, Leica X-function DBX, LandXML, PTZ

Specifications subject to change without notice *At 50 m range, one sigma **One sigma
See Leica ScanStation Product Specifications for full technical data

Whether you're designing a modification to a complex refinery piping system, surveying a site or documenting a historic building, you need reliable measurements. High-Definition Surveying™ scanning systems and software by Leica Geosystems provide you with exact data of what's there.

When your as-built information has to be right, rely on Leica Geosystems, the company that professionals trust for their scanning solutions. Leica Geosystems is best known for pioneering scanning technology with trustworthy, total solutions: versatile, accurate laser scanners, industry standard point cloud software, and a full complement of accessories, training and support.

Precision, quality and service from Leica Geosystems.

When it has to be right.

753316enUS – I.07 – RDV

Laser class 3R in accordance with IEC 60825-1 resp. EN 60825-1

Leica ScanStation
Product information and specifications

Leica HDS6000
Product information and specifications

Leica Cyclone 5.6 SCAN
Product information

Leica Cyclone 5.6 MODEL, SURVEY
Product information

Leica Cyclone 5.6 REGISTER
Product information

Business Unit Scanning:
Leica Geosystems HDS LLC
4550 Norris Canyon Road
San Ramon, USA, CA 94583
+1 925 790-2300

Leica Geosystems AG
Heerbrugg, Switzerland

www.leica-geosystems.com/hds

- when it has to be **right**

Leica Geosystems

Leica ScanStation
A new level of versatility in laser scanners

Advanced features include dual-axis compensation and faster scanning for highest versatility, plus excellent productivity and ease-of-use

ScanStation: new class of scanner sets a new standard

The integration of survey-grade, dual-axis (tilt) compensation into the industry's most popular laser scanner platform has created Leica ScanStation – a new class of laser scanner and a new level of scanner versatility for as-built and topographic surveys. It's the first instrument to combine four fundamental total station features into one scanner: (1) full field-of-view, (2) survey-grade, dual-axis (tilt) compensation, (3) survey-grade accuracy for each measurement, and (4) excellent, useful range.

Full field-of-view

ScanStation features a full field-of-view, like that of a total station, providing users with optimum versatility and productivity.

Survey-grade dual-axis (tilt) compensation

ScanStation employs the same 1" resolution, dual-axis (tilt) compensator as in a Leica total station. Users can set up over known points, take advantage of familiar traverse and resection workflows, and even stakeout. Benefits include lower field & office costs and greater field flexibility.

Survey-grade accuracy for each measurement

Leica ScanStation delivers survey-grade accuracy for each measurement, just like a total station. ScanStation's ultra-fine scanning and small laser spot –even at long range- also let users achieve optimal project control and registration.

Excellent practical, useful range

ScanStation's pulse-based capture range (up to 300m for 90% surface reflectivity) combine with its narrow beam and ultra-fine scanning capabilities to handle the vast majority of typical sites for reflectorless instruments. Get more information or contact Leica Geosystems for a demonstration at: www.leica-geosystems.com/hds

- when it has to be **right**

Leica Geosystems

Leica ScanStation
Product Specifications

General

Instrument type	Pulsed, dual-axis compensated, high-speed laser scanner, with survey-grade accuracy, range, and field-of-view
User interface	Notebook or Tablet PC
Scanner drive	Servo motor
Camera	Integrated high-resolution digital camera

System Performance

Accuracy of single measurement

Position*	6 mm
Distance*	4 mm
Angle (horizontal/vertical)	60 µrad/60 µrad, one sigma
Modeled surface precision/noise**	2 mm, one sigma
Target acquisition***	2 mm std. deviation
Dual-axis compensator	Selectable on/off Resolution 1", dynamic range +/- 5'
Data integrity monitoring	Periodic self-check during operation and startup

Laser Scanning System

Type	Pulsed; proprietary microchip
Color	Green
Laser Class	3R (IEC 60825-1)
Range	300 m @ 90%; 134 m @ 18% albedo
Scan rate	Up to 4,000 points/sec, maximum instantaneous rate Average: dependent on specific scan density and field-of-view

Scan resolution

Spot size	From 0 - 50 m : 4 mm (FWHH - based); 6mm (Gaussian - based)
Selectability	Independently, fully selectable vertical and horizontal point-to-point measurement spacing†
Point spacing	Fully selectable horizontal and vertical; 1.2 mm minimum spacing, through full range†
Maximum sample density	1.2 mm†
Scan row (horizontal)	20,000 points/row, maximum†
Scan column (vertical)	5,000 points/column, maximum†

Field-of-view (per scan)

Horizontal	360° (maximum)†
Vertical	270° (maximum)†
Aiming/Sighting	Optical sighting using QuickScan™ button
Scanning Optics	Single mirror, panoramic, front and upper window design Environmentally protected by housing and two glass shields
Scan motors	Direct drive, brushless

Data & power transfer to/from rotating turret

Contact-free: optical data link and inductive power transfer

Communications	Static Internet Protocol (IP) Address
Integrated color digital imaging	User-defined pixel resolution: Low, Medium, High† Single 24° x 24° image: 1024 x 1024 pixels (1 megapixel) @ "High" setting Full 360° x 270° dome: 111 images, approx. 64 megapixels, automatically spatially rectified
Status Indicators	3 LEDs (on stationary base) indicate system ready, laser "on", and communications status

Level indicator	External bubble and via laptop

Electrical

Power supply	36 V; AC or DC; hot swappable; two (2) Power Supply units provided with system
Power consumption	< 80W avg.
Battery type	Sealed lead acid
Power ports	Two (2) simultaneous use, hot swappable
Typical duration	>6 hours, typical continuous use (room temp.)
Power status indicators	Five (5) LEDs indicate charging status and power levels

Environmental

Operating temp.	0° C to +40° C
Storage temp.	-25° C to +65° C
Lighting	Fully operational between bright sunlight and complete darkness
Humidity	Non-condensing
Shock	40 G's (max. to scanner transport case)
Dust/humidity	IP52 (IEC 60529)

Physical

Scanner

Dimensions	10.5" D x 14.5" W x 20" H 265 mm x 370 mm x 510 mm w/o handle and table stand
Weight	19.5 kg, nominal

Power Supply Unit

Dimensions	6.5" D x 9.25" W x 8.5" H 165 mm x 236 mm x 215 mm w/o handles
Weight	12 kg, nominal

Standard Accessories Included

Scanner transport case
Tribrach (Leica Professional Series)
Survey tripod
Ethernet cable for connection of scanner to notebook PC
Two Power Supply cases. Each includes:
- Power Supply
- Cable for battery connection to scanner
- Power Supply charger

User manual
Cleaning kit
Cyclone™-SCAN software

Hardware Options

Notebook PC
Tablet PC
HDS scan targets and target accessories
Service agreement for Leica ScanStation
Extended warranty for Leica ScanStation

Notebook PC for Scanning$^{\Delta}$

Component	**required (minimum)**
Processor	1.4 GHz Pentium M or similar
RAM	512 MB SDRAM
Network card	Ethernet
Display	SXGA+
Operating system	Windows XP (SP1 or higher) Windows 2000 (SP2 or higher)

Cyclone-SCAN

Independent vertical and horizontal scan density †
Scan filters: range, intensity †
Selection of scan area via scribed rectangle or pre-sets†
Atmospheric correction
Customizable longitude/latitude grid lines
Targeted, single-shot pre-scan ranging †
Script management for auto scan sequencing †
View scanner locations and field-of-view
Level of detail (LOD) for fast visualization
Auto rechecking (re-acquisition) of targets †
Auto acquisition of HDS targets †
Target identification
Traverse †
Field Setup - Resection †
Field Setup - Known Backsight †
Field Setup - Known Azimuth †
Traverse and resection reports
Stakeout and id-point
Direct coordinate/station entry †
Dual-axis compensation on/off
Engage/disengage turret
Target and instrument height input
Lighting control for digital images
Acquire and display digital image
Set image resolution (high, medium, low)
Support of external digital images
Real-time 3D visualization while scanning †
Fly-around, pan & zoom, rotate clouds, meshes, models in 3D
View point clouds with intensity or true-color mapping
Auto creation of panoramic digital image mosaic †
Global digital image viewer †
Point-and-scan QuickScan to set horizontal FoV †
User-defined quality-of-fit checks
Measure & dimension: slope dist., ΔX, ΔY, ΔZ
Create, manage annotations and layers
Save/restore views
Save screen images
Undo/redo support

Direct Import Formats

Cyclone native IMP object database format, Cyclone Object Exchange (COE) format
ASCII point data (XYZ, SVY, PTS, PTX, TXT)
Leica's X-Function DBX format, Land XML, ZFS, ZFC, 3DD

Direct Export Formats

ASCII point data (XYZ, SVY, PTS, PTX, TXT), DXF
Leica's X-Function DBX format, Land XML, PTZ

Indirect Export Formats

AutoCAD (via AutoCAD, COE for MicroStation plug in)
MicroStation (via COE for MicroStation plug-in)
PDS (via MicroStation, COE for MicroStation plug-in)
AutoPLANT (via AutoCAD, COE for AutoCAD plug-in)

Ordering Information

Contact Leica Geosystems or authorized manufacturer's representatives

All specifications are subject to change without notice.
All ± accuracy specifications are one sigma unless otherwise noted
† SmartScan Technology™ feature
* At 1 m – 50 m range, one sigma
** Subject to modeling methodology for modeled surface
*** Algorithmic fit to planar HDS targets
Δ Minimum requirements for modeling operations are different. Refer to Cyclone data sheet specifications

Laser class 3R in accordance with IEC 60825-1 resp. EN 60825-1

753664enUS – I.07 – RDV

Leica Geosystems AG
Heerbrugg, Switzerland
www.leica-geosystems.com/hds

- when it has to be **right**

Leica Geosystems

ANNEX C

LEICA GEOSYSTEMS PRESS RELEASES

#84865642912

Press Releases

The Latest News

Leica Geosystems Awarded Contract to Supply High-Definition Surveying (HDS) Equipment to California Highway Patrol

8 November 2006

Multidisciplinary Accident Investigation Teams Ensure Accuracy and Speed When Opening a Scene by Using Leica ScanStation

(Norcross, GA) Today, Leica Geosystems announced that the company has been awarded a contract to supply high-definition surveying equipment to the California Highway Patrol (CHP).

The Multidisciplinary Accident Investigation Teams (MAIT), a specialized unit of the CHP, conducts indepth investigations and analyses of major traffic collisions throughout the state. The MAIT studies environmental, human and mechanical factors that may have contributed to collisions, with the ultimate objective being the utilization of these identified causal factors in the prevention of similar incidents. MAIT officers are trained in the physics of collision analysis and reconstruction, and they use Leica Geosystems' surveying equipment in order to map collision scenes. The team recently purchased five Leica ScanStation 3D laser scanners and accompanying Cyclone software in order to document severe and complex accidents involving multiple fatalities, officer-involved shootings or officer injuries.

"When we get a call-out to a scene, our goal is to quickly, accurately and completely document it," said Lieutenant David Fox, MAIT program coordinator. "The Leica ScanStation allows us to do that and get the roadway open sooner. We were looking for a scanner that combines high-accuracy, long-range, full field-of-view and dual-axis compensation, which allows our officers to use it like a surveyor's total station. The Leica ScanStation fulfills all these requirements. This, along with the excellent technical support we have always received from Leica Geosystems, has enhanced our ability to get the job done."

The CHP MAIT have long used Leica System 1200 survey-grade GPS and total stations for major accident investigations. With this purchase, the CHP will have a full complement of Leica Geosystems measurement tools for their investigations.

"The ScanStation has the ability to essentially digitize and record in 3D, an entire scene exactly the way the first responder found it. This can be done day or night, indoors or out. Using the point cloud, investigators can quickly create detailed scene diagrams, reconstruct bullet trajectories and verify or disprove witness statements regarding what they saw. Another developing trend is for police agencies to deploy Leica Geosystems scanners as part of a broader risk management strategy for investigations concerning officer-involved shootings, which sometimes result in costly civil litigation," said Tony Grissim, Leica Geosystems' law enforcement account manager.

The CHP is drafting procedures and standards for forensic laser scanning to comply with the guidelines currently being established by the International Association of Forensic and Security Metrology (IAFSM), a recently formed non-profit professional association of users, service providers and manufacturers of metrological techniques and technology working for the advancement of justice. The president of the IAFSM is Captain Larry Sonntag, head of the Scientific Evidence Division of the Albuquerque Police Department, which also uses the Leica ScanStation for crime scene investigation (CSI). Leica Geosystems is a charter member of the IAFSM and provides input to the association membership in their role as technical advisors.

Leica Geosystems – when it has to be right
With almost 200 years of pioneering solutions that measure the world, Leica Geosystems' products and services are trusted by professionals worldwide to help them capture, analyze and present spatial information. Leica Geosystems is best known for its broad array of products that capture accurately, model quickly, analyze easily, and visualize and present spatial information.

Those who use Leica Geosystems products every day trust them for their dependability, the value they deliver, and the superior customer support. Based in Heerbrugg, Switzerland, Leica Geosystems is a global company with tens of thousands of customers supported by more than 2,400 employees in 22 countries and hundreds of partners located in more than 120 countries around the world. Leica Geosystems is part of the Hexagon Group, Sweden.

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The California Highway Patrol uses Leica ScanStations to investigate major accidents.

#84865642912

Press Releases

The Latest News

Police Investigation, Using Leica Geosystems' Laser Scanner, Assists Engineers Repairing Collapsed Freeway

7 August 2007

Positioning technology provides data density, speed and safety to authorities documenting a complex accident scene

Leica Geosystems redefined the word "support" when it assisted the California Highway Patrol's (CHP) Multidisciplinary Accident Investigation Team (MAIT) at the recent collapse of a major San Francisco-area overpass. The CHP not only brought a Leica ScanStation 3D laser scanner with them to map the scene, but Leica Geosystems also responded by dispatching an application engineer to help collect and process the accident scene data.

The accident occurred in the early morning hours on April 29th, when a tanker truck carrying over 8,600 gallons of gasoline crashed on the "MacArthur Maze", an approach to the San Francisco-Oakland Bay Bridge, igniting a 3000° F fire and causing the I-580 overpass to collapse onto an interstate below.

The CHP was on the scene within minutes of the incident and once it was safe, MAIT members set up the Leica ScanStation and systematically scanned the scene, collecting high-accuracy laser scan data from the ground to the top of the destroyed overpass. Leica Geosystems' application engineer arrived on scene a short time after scanning began and was on hand to assist the CHP if needed in documenting the scene – a process that didn't end until after midnight.

Recording forensic evidence to map the complex 3D-accident scene was further complicated by contractors demolishing the overpass as MAIT members were scanning the scene.

Lieutenant Dave Fox, MAIT's Team Manager, said Leica Geosysetms' ScanStation greatly increased their data-collection productivity and provided them with a much denser dataset than they could gather with conventional methods.

"The ScanStation enabled us to be very mobile and efficient while collecting very detailed data," said Lt. Fox. "Typically we can acquire 500-1,000 points; with Leica Geosystems' 3D laser we collected millions. We couldn't have collected that kind of information without laser scanning."

Leica ScanStation also enabled the CHP to collect data more safely, said Tony Grissim, Leica Geosystems' Forensic Account Manager. "There were many areas at the scene where it was unsafe to walk. Since Leica's ScanStation allows you to acquire data remotely, MAIT officers could document critical sections of the infrastructure from a safe distance."

Grissim also facilitated the interest and support of Caltrans (California's DOT) to use the high-accuracy scan data for its on-going analysis and reconstruction of the overpass failure. Once the CHP finished scanning the scene, Leica Geosystems' application engineer acquired a copy of the data and hand-delivered it to Caltrans the following morning. In the following days Leica Geosystems continued its support and provided both Caltrans and the CHP with the technological resources and expertise they need for their complex investigation.

Caltrans intends to make the scan data available to the general public on the Web using Leica Geosystems' free downloadable TruView point cloud viewer.

About Leica Geosystems HDS, LLC
Leica Geosystems HDS LLC http://hds.leica-geosystems.com/ is based in San Ramon, California. The company specializes in the development, manufacture and marketing of High-Definition Surveying™ (also known as 3D laser scanning) systems and software. These products are used for performing as-built, detail, engineering, and topographic surveys for a variety of 2D & 3D mapping and modeling applications in the AEC and other markets. The company was founded in 1993 as Cyra Technologies, was acquired in 2001 by Leica Geosystems AG, and operates as a wholly owned subsidiary. The company is a leading hardware and software vendor in this emerging market.

Leica Geosystems – when it has to be right
With close to 200 years of pioneering solutions to measure the world, Leica Geosystems products and services are trusted by professionals worldwide to help them capture, analyze, and present spatial information. Leica Geosystems is best known for its broad array of products that capture accurately, model quickly, analyze easily, and visualize and present spatial information even in 3D. Those who use Leica products every day trust them for their dependability, the value they deliver, and the superior customer support. Based in Switzerland, Leica Geosystems is a global company with tens of thousands of

customers supported by more than 2,400 employees in 21 countries and hundreds of partners located in more than 120 countries around the world.

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ANNEX D

NEWS CLIP/PRESS ADVISORY
&
MAGAZINE ARTICLES

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Leica Geosystems, HDS

01/02/2008

Fifth User Conference and HQ, San Ramon, USA

Terrestrial laser scanning combines a high level of detail with surveying accuracy for the creation of 3D-models of virtually any object. The technology literally opens up new dimensions and so attracts widespread attention. It is in the interest of manufacturers t bring these people together for cross-fertilisation of ideas, so to dri the makers on towards problem solving and new survey solutions. Leica Geosystems HDS held the fifth such get-together in Californ from 22nd to 24th October 2007.

By Mathias Lemmens, editor-in-chief, GIM International

Arriving tired and tense after an intercontinental flight, the journey from San Francisco International Airport to San Ramon feels fraught. After a ninety-minute train trip on the BART (Bay Areas Rapid Transit) "blue line" to the Dublin/Pleasanton terminal, it tak another twenty minutes to get to the Marriott Hotel, venue for the fifth Leica Geosystems HDS User Conference. The hotel is in the middle of a business district; ten minutes' walk from Leica Geosystems HDS headquarters. The ice-breaker reception provides an opportunity for me to meet Geoffrey Jacobs, senior vice-preside strategic marketing, and moderator at the event. In the US, Geoffre is widely considered a leading expert in the laser-scanning industry a reputation probably due in part to his authoring more than thirty feature articles published in our US sister magazine, Professional Surveyor . His articles cover a wide range of business and technica aspects, and conference participants were later to confess their 'understanding of laser-scanning technology and its business

○ non-existing
○ a minor obstacle
○ merely administrative
○ a blockade
Vote

opportunities started much from reading Geoffrey's articles'.

Market Growth
Monday morning, and Dr Juergen Dold, introduced by Geoffrey Jacobs as Leica head of imaging and scanning business, kicks off tl conference. 'Terrestrial laser scanning (TLS) or High-Definition Surveying (HDS), as we at Leica have redefined the technology, is market which has rapidly grown in the last four years, and the growth will continue', he predicts. A diagram showing year as horizontal axis proves exponential development in the number of laser scanners installed by Leica from 2000 onwards. Aligned with the vertical axis is the term "unit", without quantification. Another slide illustrates greatest usage of Civil and Plant applications. Later presentations underpin this. For example, Bill Campbell, General Motors Corporation, Detroit, discusses how 3D as-built models created with TLS are used in plants all over the world. Engineers ai suppliers thus gain instant access to the data via the web, using Leica's free TruView software.

Heritage
Acknowledging growth in the Plant segment, Tuesday afternoon sa two parallel tracks, one on Plant and the other on Civil/Survey/Architecture. The strong rise in Plant is in part driven by the 2006 release of the HDS6000, a phase-shift scanner which can measure up to 500,000 points per second. 'In the building sectc including architecture, facility management and heritage documentation, market size is of medium level, although the longer term potential is significant,' Dold continues. Nevertheless, produc in this segment can be very impressive, as Doug Pritchard, head of Visualisation at Glasgow School of Art in Scotland demonstrated ii his presentation of highly detailed, photo-textured 3D-city models (Glasgow, a project funded by the European Union. The models wei created by two scanning surveyors and six, sometimes eight, modellers, over about an eighteen-month period, starting in the summer of 2006. 'Glasgow is an old city with many narrow and curved streets, so 3D-modelling needs substantially more time than for a new city like Toronto,' Pritchard explained. Heritage documentation is not so much an industry as a university research activity. During lunch on the first day Prof. Carlo Bianchini of the University of Rome, Italy, presented an overview of his work documenting some of the world's greatest heritage sites, including the Coliseum and Antonio da Sangallo's wooden model of a desigr for St. Peter's Cathedral, which was never built. He also showed, fc the first time in public, scans of the interior of today's St. Peter's Cathedral. On the Wednesday of conference his co-worker, Alfonsı Ippolito, discussed findings and developments to model complex structures such as domes.

Accidents and Forensics
The police and the military also benefit from TLS for such

applications as traffic-accident survey and forensic research. This market is not so extensive as Civil and Plant, and growth potential : medium. Lieutenant Dave Fox, Highway Patrol (CHP), California, gave an impressive presentation on accident surveying, 'Each accident scene needs to be surveyed quickly, accurately and completely. Seeing the potential of TLS, in 2006 we bought no fev than five scanners.' Fox went on to highlight an extraordinary road accident which took place in the early morning of 29th April 2007 on an approach to the San Francisco-Oakland Bay Bridge. 'A tanke truck carrying over 30,000 litres of gasoline crashed and went up ir flames. The heat caused an overpass to collapse onto an interstate (highway) below.' A few minutes later CHP's Multidisciplinary Accident Investigation Team (MAIT) was on site and scanned the overpass from ground to top, assisted by Leica engineers. Accordin to the MAIT team manager, 'With conventional means we collect just five hundred to a thousand points, with laser scanning, million: And it is fast and safe, as unsafe positions can now be measured remotely. Also, the road can be reopened sooner, and high detail ar accuracy allows not only accident reconstruction but is also useful for civil engineers.' Craig Fries, founder and principal of Precision Simulations, showed convincing examples of how crime scenes could be reconstructed by combining laser-scan data taken after the crime with forensic information. Scanning is contracted out to surveyors. Using point-cloud-processing software Cyclone and oth tools, simulations of the past are created and taken to court. Such simulations are extremely visually convincing, imitating the realisn of film, and so often convinces juries that this is how it happened.'

Cyra Technologies

Laser scanning is not an autonomous development on the part of Leica but was introduced into the company through acquisition of Cyra Technologies in 2001. Cyra founder Ben Kacyra has a background in civil engineering and graduated from the University of Illinois in 1965. In 1973 he co-founded Cygna, an engineering company in San Francisco offering design and construction management services. After the merger of Cygna with another US-based firm in 1989, Mr Kacyra founded Cyra Technologies in 199: in Oakland, California. 'The idea of developing and producing lase scanners stemmed from his engineering and construction background,' Geoffrey Jacobs tells me. 'There he saw that as-built surveys were carried out by large groups of field workers basically making manual measurements using tapes and theodolites and still producing incomplete and inaccurate drawings of complex piping and structures. This could be done faster, easier and better using advanced technology!' The resulting measurement system, Cyrax, was brought to market in 1998; a year later, thirty instruments had been sold. The success of the system attracted the attention of bigg players, and so it was that in February 2001 Leica Geosystems acquired Cyra Technologies, since April 2004 formally named Lei Geosystems HDS Inc and based in San Ramon, California. The yea

2001 marked, incidentally, the highest number of acquisitions sinc€ Leica's founding as Kern and Co in 1819 in Aarau Switzerland. Leica not only bought Cyra but was also augmented by Laser Alignment Inc, Grand Rapids, MI, and ERDAS, Inc, Atlanta, GA, while the remaining 50% of LH Systems, San Diego, were also acquired. Although financially well positioned, Ben Kacyra did not retire but realigned the letters of his family name and founded non-profit organisation CyArk. Recognising the threats facing the world's most valued cultural heritage sites, CyArk collects accurate digital 3D-models by TLS and stores them in a publicly accessible archive(http://archive.cyark.org). CyArk's main sponsor is the Kacyra Family Foundation, formed to foster humanitarian, cultural and scientific endeavour in heritage, medical research, human ener; and education.

Market Leader

'Today we are acknowledged as the market leader in laser scanning we have shipped almost 1,500 scanners,' Dold tells me. 'This is no only a result of the take-over of the best laser-scanner manufacturer and software developer at that time, although it contributed a lot; th people with Cyra all were excellent researchers, engineers and developers. It is also because Hexagon, the company who owns Leica Geosystems, wants to remain the leading manufacturer over the entire measurement space, from micrometre to kilometre.' As a result, the company invests heavily in research and development. 'We deliver to our customers what we promise; we do not need exaggerated marketing efforts to convince our customers. Quality, high service and support levels, and successful users are our best marketing.' In response to my asking him why he had introduced th term "High-Definition Surveying" to identify the technology, rathe than using a conventional term like Terrestrial Laser Scanning, he elaborates in detail. 'The term HDS appeared on the horizon when we had to think about a name change for the predecessor of Leica Geosystems HDS. The need for renaming popped up because Cyra Technologies became closely integrated with other parts of the company. The HDS3000 laser scanner, the first to have the look an feel of a survey instrument, was jointly developed by the teams in Switzerland and California, and sales and support goes along Leica lines. The terms High-Definition Surveying and HDS were formall introduced at the Intergeo 2003 conference. HDS clearly expresses how the technology differs from other geometric data-capture methods in terms of capturing detail, and it was quickly accepted ai picked up by customers. The term also received strong support fror editors of leading industry trade publications. The term perfectly describes where we are going to with this exciting technology. Our application for registration of "HDS" as an International Trademarl was approved by many of the countries with which we do business. So we renamed the division "Leica Geosystems HDS Inc" in 2004.

Calibration and Repair

I accompany Mathias Svensson, Stefan Nyberg and Peter Berg, all Scandinavian energy-provider Vattenfall, in a short car journey to Leica Geosystems HDS headquarters. On the way Mathias Svensoı tells me a little about the Sweden-based Vattenfall, founded in 190: and transformed in 1992 from a public energy provider into a state-owned company. The company uses laser scanning for rebuilding and documenting plants, for simulation and visualisation of new constructions and emergency projects, and also for logistical planning and time schedules. We are welcomed to HDS by Hendril Bartel, product manager. 'San Ramon houses the Leica Geosystem: HDS HQ and a services department, but manufacturing of laser scanners is now completely done in Switzerland. That is a well-considered choice. Before Hexagon took over Leica in 2005 the production of airborne laser scanners had already been moved fron Massachusetts, US, to the main manufacturing plant in Heerbrugg, Switzerland; terrestrial laser scanners followed the same route.' Dennis McLaughlin, director of manufacturing, adds, 'The move tc Switzerland is a very natural one. There we have all the expertise available for manufacturing instruments. In addition, although Switzerland is not the cheapest spot on earth, the San Francisco Ba; area is known for its exceptionally high manufacturing labour costs Yes, my business card still tells me I am director of manufacturing, but "product innovation support" would be the better term, because that is what we focus on and we are here running a state-of-the-art test, calibration and repair facility. So our customers in the Americ: will still be able to get prompt service and support.' Indicating the laser scanners on show in the reception hall, Dennis McLaughlin goes on, 'ScanStation 2 was introduced July 2007. Although it look from the outside very similar to ScanStation 1, at 50,000 points/sec scan speed, it is more than ten times faster than its long-range, time of-flight predecessor.' In November 2006 the compact HDS6000 was announced as successor to the short-range, phase-based HDS4500 scanner. (Check GIM's Product Survey on Terrestrial Laser Scanners, August 2007, vol. 21, no. 8.) Dennis continues, 'O scanners can operate everywhere on earth, as long as the air temperature is not too far below zero and not above fifty degrees Celsius. Sub-Saharan Africa and other tropical countries are no problem; the instruments can cope with high humidity, but rapid change of humidity is an issue.' He ushers us into the calibration hall, a huge room where the tuning parameters of scanners are accurately determined. 'Laser scanners are like individuals,' he say 'Each has its own character, and to get acquainted with that takes a lot of time. So laser scanners are subjected to our full attention ove a twelve-hour periodand the resulting parameters quantified and stored onboard.' To avoid having to go outside for testing, the company has installed an indoor test-range over 100m in length.

Error Analysis

This user conference does not include many mathematical presentations; it is, as its name implies, a meeting of users and not ;

gathering of scientists. But during one presentation on estimating error when measuring between two scan data-points in TruView software, the presenter, a Leica expert, confirmed the preconceptio that American knowledge of maths is somewhat underdeveloped. His slides included a lengthy "derivation" to demonstrate that the standard deviation (SD) of the outcome of the sum of two paramete can be obtained by taking the SD of one of the two and multiplying the result by 1.4, provided that the size of both SDs are similar. Although this is not incorrect, one wonders why error propagation need be deconstructed to such an elementary level, clarifying nothing while endorsing a misconception all too often present in th heads of laymen, that is that standard deviations can be summed up When R = P+Q, the standard deviation of R (SDR) reads square ro of (SDP^2+SDQ^2), with SDP and SDQ standard deviations of P and Q respectively. When SDP and SDQ are similar in size (i.e. SDQ = SDP) then SDR reduces to the square root of 2 SDP^2, which equals 1.4 SDP. And that's about it, folks!

Final Remarks

Many survey companies feel the need to take the step into TLS, bu there is still much to learn and much uncertainty. Sometimes it is better to share experience and carry out a co-operative project with two or three firms. Some companies were in San Ramon because they were considering making the move towards exploring the technology as part of their services. Total registration for the fifth user conference was close on three hundred participants from seventeen countries, an increase of 25% over last year. At the end c the conference Juergen Dold announced plans for another such conference in 2008, probably also in October and in the US, locatic to be announced. Back to my opening complaint: another site woul do the next conference no harm!

References

http://www.lgshds.com/

Print Send to

Thursday, November 15, 2007

Scanner Could Speed Up Crash Investigations

By Lee Ross

Mountain View Telegraph

Retired Albuquerque Police Department captain Larry Sonntag was the victim of a fake "homicide" Friday, complete with a smattering of bullet shells, evidence markers and a length of plumbing pipe to simulate a blunt instrument.

Sonntag's body was scanned during a demonstration of a Leica Geosystems laser scanner in Bernalillo County Sheriff Darren White's conference room in Downtown Albuquerque.

The scanner is not only used in homicide investigations, according to Leica's forensic account manager Tony Grissim, who ran the demonstration.

Leica's scanner has reduced the time it takes for the California Highway Patrol's crash investigations by up to 50 percent, according to Grissim. He said the highway patrol has had five of the scanners for several years and is looking to purchase a few more.

State Rep. Kathy McCoy said the system might have been used to speed up the investigation of a five-car wreck on Aug. 22 that closed I-40 in Tijeras Canyon for several hours.

"I think this is one possible tool to expedite the process," she said in an interview after the demonstration.

McCoy pointed out another benefit of being able to move a crash investigation along more quickly.

"The faster you move, the less chance of secondary accidents," she said.

A complete scanning of an accident scene for police purposes may take about 10 minutes, according to Grissim. He said a more complex crash may take longer.

The advantage, Grissim said, is that the scanner eliminates the need for extensive photographing and measuring on the scene. Once the scanner gathers the data, all that can be done later.

Results for the laser scan of the fake homicide took only a few minutes. A screen in the conference room displayed a digital photo of the "crime scene" superimposed over three-dimensional data gathered by the laser.

Grissim measured the distance from Sonntag's head to the evidence markers. According to a Leica brochure, those measurements are accurate within four millimeters.

There was one problem with the image, however. Because Sonntag had moved, part of his head was distorted.

"Usually that's not a problem with your homicide victims," Grissim said.

The laser scanner comes with a price tag of about $200,000, which includes training for law enforcement and a three-year service agreement.

A sizable price tag is not its only potential drawback.

"It is probably impractical to put it in your average patrol car," Grissim said.

The scanner, which is about the size of a large bread box, is transported in an even larger, shock-resistant case.

Bernalillo County Commissioner Michael Brasher, who also attended the demonstration, said portability may be a problem at a crash site.

"If you have to go back and get it and take it back (to the accident scene) ... " he said, shrugging.

In spite of potential drawbacks, a similar scanner was purchased for the Albuquerque Police Department in 2006.

"I had an opportunity to actually watch it in action at Germain Casey's crash," White said.

The crash killed Casey, a Rio Rancho police officer, in August.

"We do have one (laser scanning) system in New Mexico, but we need more," White said.

The demonstration was part of an ongoing cooperative effort to try to alleviate traffic jams in Tijeras Canyon that paralyze a wide area.

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LASER SCANNERS: High-definition surveying plays increasing role in disaster recovery

At 3:42 a.m. on April 29th, a tanker truck carrying more than 8600 gallons of gasoline crashed on the "MacArthur Maze," a heavily traveled approach to the San Francisco-Oakland Bay Bridge. The crash ignited a 3000° F fire that softened the steel frame of the freeway enough that the eastbound Interstate 580 connector fell onto the Interstate 880 connector below it.

In the repair effort, a 165 ft segment of eastbound 580 had to be demolished, new steel girders and a concrete support column constructed and installed, and 200 cubic yards of concrete poured for the deck. Both freeways were fully restored within 26 days.

As part of the investigation that began as soon as it could safely be performed, the California Highway Patrol (CHP) Multidisciplinary Accident Investigation Team (MAIT) collected laser-scan data from the ground to the top of the destroyed overpass (see figure). Recording of forensic evidence took place at the same time as contractors were demolishing the overpass. The process of fully documenting the scene ended after midnight.

Laser scanning is finding increasing use for damage assessment and forensic surveys in what Geoff Jacobs, senior vice president of strategic marketing at Leica Geosystems (Norcross, GA), describes as "high-end" incidents, involving potentially large lawsuit settlements, high-visibility incidents such as terrorist actions, or incidents in which a valuable asset has been damaged and must be quickly returned to normal use.[1]

Prominent examples include investigations of the Princess Diana accident in a Paris underpass; analysis of the USS Cole explosion, the Bali resort bombing, and the London Underground and bus bombings of 2005, as well as surveying damage to oil and gas platforms damaged by Hurricane Ivan in 2004. The MacArthur Maze crash last spring is a case in which laser scanning enabled rapid data gathering, as part of an overall effort to repair a valuable public asset and return it quickly back to service.

Jacobs notes several key factors for the growth in value of laser scanning in high-profile forensics and damage assessment. High data-point density has become essential for documenting highly irregular surfaces of the type that are common in damage assessment, while ultrafast data capture aids in situations where cleanup and repair must begin immediately. Remote, reflectorless measurement, as well as the potential for robotic operation, are valuable in dangerous situations. In addition, 3-D visualization enables computer-generated imagery to provide views of a structure from angles or perspectives that might otherwise be impossible to obtain, and the potential for imagery with enhanced information processing (such as false coloring) can provide structural information otherwise invisible by simply viewing a potentially damaged structure or area.

Lt. Dave Fox, MAIT's team manager, said the laser scanner greatly increased the workers' data-collection productivity and provided them with a much denser dataset than they could gather with conventional methods. "The ScanStation enabled us to be very mobile and efficient while collecting very detailed data," he said. "Typically we can acquire 500 to 1000 points; with Leica's 3-D laser we collected millions. We couldn't have collected that kind of information without laser scanning."

Laser scanning also enabled the CHP to collect data more safely, said Tony Grissim, Leica Geosystems' forensic account manager. "There were many areas at the scene where it was unsafe to walk," he said. "Since Leica's ScanStation allows you to acquire data remotely, MAIT officers could document critical sections of the infrastructure from a safe distance."

Hassaun A. Jones-Bey

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Bridge collapse triggers quick response
Bridges Staff

OAKLAND, Calif.—A gasoline tanker truck that crashed and burned on early Sunday morning, April 29, caused the collapse of a freeway bridge in one of the nation's busiest interchanges in Oakland, Calif.—the MacArthur Maze—near the east end of the San Francisco-Oakland Bay Bridge. According to the California Department of Transportation (Caltrans), the westbound I-80 connector to southbound I-880 and the eastbound I-80 to eastbound I-580 connectors were closed by the collapse. Two, 82-foot-long bridge spans were damaged, Caltrans says, eliminating routes used by about 80,000 vehicles a day.

Debris removal and demolition began immediately with emergency funding provided by the state and the Federal Highway Administration. Following around-the-clock debris removal and repair, the I-880 connector opened to traffic on Monday morning, May 7.

During debris removal, California Highway Patrol's (CHP) Multidisciplinary Accident Investigation Team (MAIT) used a Leica ScanStation 3-D laser scanner to map the scene. Leica Geosystems also dispatched an application engineer to help collect and process the accident scene data.

The California Highway Patrol used a 3-D laser scanner to map the scene of a freeway bridge collapse.

MAIT members systematically scanned the scene, collecting high-accuracy laser scan data from the ground to the top of the destroyed overpass. Recording forensic evidence to map the complex 3-D-accident scene was complicated by contractors demolishing the overpass as MAIT members were scanning the scene.

Caltrans expects to use the high-accuracy scan data for its on-going analysis and reconstruction of the overpass. Once the CHP finished scanning the scene, Leica Geosystems' application engineer acquired a copy of the data and hand-delivered it to Caltrans the following morning. According to Leica Geosystems, Caltrans intends to make the scan data available to the public online using Leica Geosystems' free downloadable TruView point cloud viewer.

The repaired MacArthur Maze fully reopened on Friday, May 25, only 26 days after the accident. More information on the MacArthur Maze damage and repair, including a time lapse video of the project is available at www.dot.ca.gov/dist4/mazedamage.

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